PATENT COOPERATION TREATY

24 APR 2001

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

To:
INTERNATIONAAL OCTROOIBUREAU B.V.
Attn. Charpail, Francois
Prof. Holstlaan 6
NL-5656 AA Eindhoven
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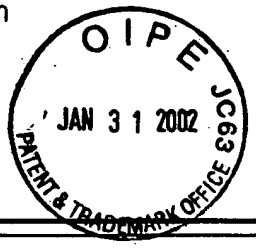

Applicant's or agent's file reference PHN 17.861WO	Date of mailing *(day/month/year)* 25/04/2001 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/EP 00/13232	International filing date *(day/month/year)* 27/12/2000
Applicant KONINKLIJKE PHILIPS ELECTRONINCS N.V.	

AMA

1. [X] The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Fascimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Doreen Golze

Form PCT/ISA/220 (July 1998)

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international pbulication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped),whether

(i) the claim is unchanged;

(ii) the claim is cancelled;

(iii) the claim is new;

(iv) the claim replaces one or more claims as filed;

(v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."

2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."

3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."

4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international appplication is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/13232

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G11B5/012 G11B20/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	K B KLAASSEN ET AL: "Electronic abatement of thermal interference in (G)MR head output signals" IEEE TRANSACTIONS ON MAGNETICS,US,IEEE INC. NEW YORK, vol. 33, no. 5, September 1997 (1997-09), pages 2611-2616-2616, XP002131949 ISSN: 0018-9464	1-6
A	figures 10,11	7
X	US 5 818 656 A (KLAAS BEREND KLAASSEN ET AL) 6 October 1998 (1998-10-06) column 3, line 41 - line 65; figure 3	1-6
X	US 6 005 726 A (MASAHIKO TSUNODA) 21 December 1999 (1999-12-21) column 6, line 13 - line 45; figure 1	1-6

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 April 2001	25/04/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gerard, E

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 847 890 A (MASAKATSU HATTORI) 8 December 1998 (1998-12-08) column 4, line 27 - line 53; figure 1	1-6
X	US 5 834 969 A (TAKEHIKO UMEYAMA ET AL) 10 November 1998 (1998-11-10) column 5, line 19 - line 29 column 5, line 57 - line 63; figure 1	1-6
X,P	EP 1 003 155 A (STMICROELECTRONICS, INC.) 24 May 2000 (2000-05-24) paragraph '0018!; figure 3	1-6
X	EP 0 439 299 A (INTERNATIONAL BUSINESS MACHINES CORPORATION) 31 July 1991 (1991-07-31)	1,4
A	column 4, line 4 - line 29; figure 2	7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 00/13232

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5818656	A	06-10-1998	NONE		
US 6005726	A	21-12-1999	JP	10097702 A	14-04-1998
			US	6101054 A	08-08-2000
US 5847890	A	08-12-1998	JP	10049806 A	20-02-1998
US 5834969	A	10-11-1998	JP	9044810 A	14-02-1997
EP 1003155	A	24-05-2000	JP	2000163705 A	16-06-2000
EP 439299	A	31-07-1991	US	5057785 A	15-10-1991
			DE	69108270 D	27-04-1995
			DE	69108270 T	19-10-1995
			JP	2051675 C	10-05-1996
			JP	3235206 A	21-10-1991
			JP	7086964 B	20-09-1995

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
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(10) International Publication Number
WO 01/50462 A1

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27 December 2000 (27.12.2000)

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(30) Priority Data:
99/16676 29 December 1999 (29.12.1999) FR

(71) Applicant *(for all designated States except US)*: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: DE JONG, Gerben, W. [NL/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). VOORMAN, Johannes, O. [NL/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). RAMALHO, Joao, N., V., L. [PT/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). GRILLO, Giuseppe [IT/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). VEENSTRA, Hugo [NL/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(74) Agent: CHARPAIL, François; Internationaal Octrooibureau B.V., Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

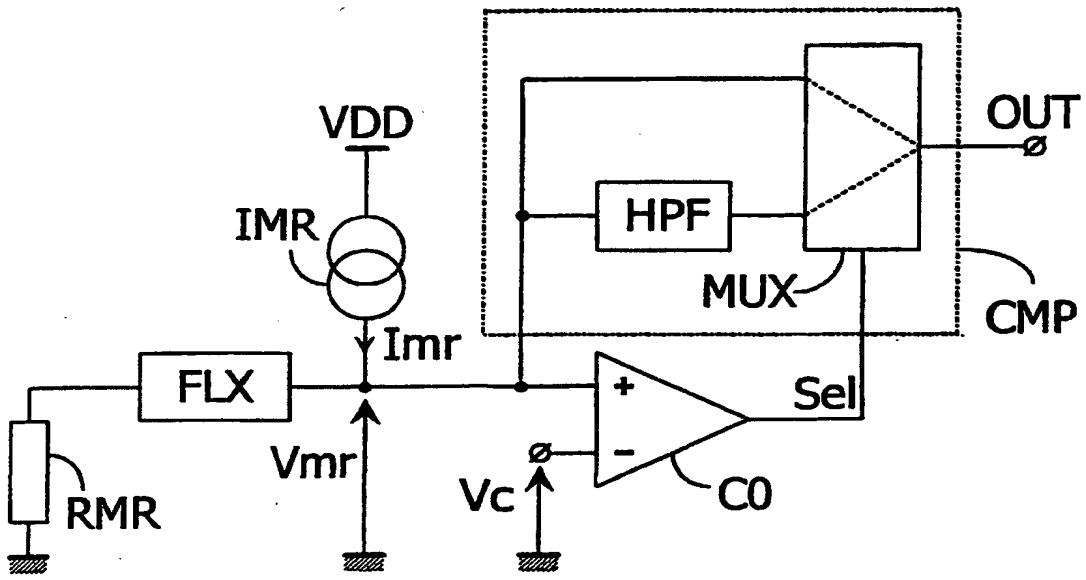
(81) Designated States *(national)*: JP, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD OF READING MAGNETIC INFORMATION WHICH IS IMMUNIZED AGAINST THERMAL ASPERITIES



(57) Abstract: The invention relates to a method of reading magnetic information by means of a read head including a magnetoresistive rod (RMR), which is to be polarized by means of an electrical signal (Imr) and serves to supply a data signal (Vmr) whose variations are representative of the magnetic-field variations to which the read head is exposed. The method in accordance with the invention includes a compression step of the data signal Vmr, which compression step is triggered off when a thermal asperity is detected. The invention enables amplifiers arranged downstream from the device to be protected against peaks in the data signal, without altering the latter under normal operating conditions. Application: hard disk readers.

WO 01/50462 A1

Method of reading magnetic information which is immunized against thermal asperities

The invention relates to a method of reading magnetic information by means of a read head, which is to be placed proximate to a support at the surface of which information is stored, which read head includes a magneto-resistive rod which is to be polarized by means of an electric signal of constant value and which serves to supply a data signal whose variations are representative of the magnetic-field variations to which the read head is exposed.

Such methods are customarily employed in the electronics industry, particularly in readers of hard discs used in the field of informatics. In these systems, a disc carrying magnetic information is driven to rotation, while the read head is made to move in a radial direction with respect to the disc, the distance between said disc and said read head being very small. The information stored on such discs consist of a vast number of local magnetic fields, which can be polarized in two different directions depending on whether they represent a binary 1 or a binary 0. As the resistance of the magneto-resistive rod depends upon the magnetic field wherein it is inserted, said resistance and hence the data signal exhibit variations when the read head moves over the surface of the disc, which variations are representative of differences between the local magnetic fields present on the disc surface.

As the distance between the read head and the disc surface is very small, the read head sometimes collides with a foreign body present between the read head and the disc surface, or with an asperity present at the surface of the disc itself. Such occurrences are referred to as "thermal asperities", because they cause a sudden increase in temperature of the magneto-resistive rod, which increase in temperature causes a sharp increase of the resistance of the magneto-resistive rod, and hence the introduction of an additional component in the data signal, thereby causing an important increase of the instantaneous value of the latter. For the reader's information: the amplitude of the additional component generated by a thermal asperity may range from 25 to 200% of the nominal amplitude of the data signal variations during normal operating conditions. The effect of a thermal asperity increases with the violence of the impact of the collision between the read head and the foreign body or the asperity.

Generally, the data signal is amplified before it is processed. For this purpose, use is made of an amplifier which is optimized for treating signals exhibiting a nominal variation amplitude. A sharp increase in the value of the data signal caused by a thermal asperity may lead to saturation, perhaps even damage, of the amplifier. In either case, a loss of information will be inevitable, which cannot be accepted.

Therefore, it is an object of the invention to overcome these drawbacks by providing a method of reading magnetic information, enabling the effects of thermal asperity on the data signal to be substantially reduced.

Indeed, in accordance with the invention, a method as described in the opening paragraph includes a data signal-compression step which is triggered off when a thermal asperity is detected.

The compression of the data signal enables the additional component introduced into the signal by the sharp increase of the resistance of the magneto-resistive rod to be eliminated to a large extent, and the amplitude of the variations of said signal to be maintained at the nominal amplitude, thereby preserving the amplifier which serves to receive the data signal. Said compression takes place only when a thermal asperity is effectively detected, thereby precluding that the data signal is needlessly subjected to a noise-generating compression step under normal operating conditions.

In an embodiment in accordance with the invention, the value of the data signal is compared with a predetermined threshold value, the result of said comparison either inhibiting or triggering off the compression step.

Such a comparison enables thermal asperities to be detected by using simple means. The threshold value determines a threshold beyond which the effects of thermal asperities are taken into account. Said threshold value thus defines the degree of significance of the thermal asperity. A thermal asperity tolerance threshold can be determined by adjusting the threshold value.

In a particular embodiment of the invention, the compression step consists in subjecting the data signal to high-pass filtering.

The frequency of the variations of the data signal is much higher than the frequency of the additional component introduced into the signal by the thermal asperity. To a certain degree, this additional component may even be considered to be a DC-component. The above-mentioned high-pass filtering thus constitutes an efficient, low-cost compression means.

In one of its embodiments, the invention relates to a device for reading magnetic information, comprising:

- a read head, which is to be placed proximate to a support at the surface of which information is stored, which read head comprises a magneto-resistive rod, which is to be polarized by means of a constant electrical signal, and which serves to supply a data signal whose variations are representative of magnetic field variations to which the read head is exposed,
- detection means for detecting a thermal asperity, and
- compression means for compressing the data signal, which are to be inhibited as long as no thermal asperity is detected.

In a variant of this embodiment, the invention also relates to a reading device as described hereinabove, comprising:

- a subtracter, which is provided with a first input intended to receive the data signal, a second input, and an output intended to supply an output signal of the device,
- a non-linear gain module, intended to receive the data signal at an input, and to supply an output signal, the gain of this module being substantially zero when the absolute value of its input signal is below a predetermined threshold value, and
- a low-pass filter provided with an input intended to receive the output signal of the non-linear gain module, and with an output connected to the second input of the subtracter.

In another variant, the invention also relates to a reading device as described hereinabove, comprising:

- a subtracter, which is provided with a first input for receiving the data signal, a second input, and an output for supplying an output signal of the device,
- a non-linear gain module, intended to receive the output signal of the device at an input, and to supply an output signal, the gain of said module being substantially zero when the absolute value of its input signal is below a predetermined threshold value, and
- an integrator, which is provided with an input for receiving the output signal of the non-linear gain module, and with an output connected to the second input of the subtracter.

The two variants described hereinabove are particularly advantageous in that they enable the structure of the detection and compression means to be simplified.

These and other aspects of the invention will be apparent from and elucidated with reference to the non-limitative exemplary embodiment described hereinbelow and the associated drawings, in which.

Fig. 1 is a partial functional diagram of a magnetic information-reading device wherein the invention is embodied,

Fig. 2 is a timing diagram showing the course of a data signal present in such a device,

Fig. 3 is a timing diagram showing the course of another signal present in such a device,

Fig. 4 is a functional diagram of compression means which are utilized in accordance with a variant of the invention,

Fig. 5 is a functional diagram of compression means which are utilized in accordance with another variant of the invention, and

Fig. 6 is a transfer characteristic of a non-linear gain module used in said variants of the invention.

Fig. 1 diagrammatically shows a read device in accordance with the invention. This device includes:

- a read head, which is to be placed proximate to a support at the surface of which information is stored, which read head comprises a magneto-resistive rod RMR, which is to be polarized by means of a constant electrical signal Imr, and which serves to supply a data signal Vmr whose variations are representative of the magnetic field variations to which the read head is exposed,
- detection means (Vc, C0) for detecting a thermal asperity, and
- compression means CMP for compressing the data signal Vmr, which are to be inhibited when no thermal asperity is detected.

In the example described here, a current source is arranged between a supply terminal VDD and a flexible conductor FLX connecting the magneto-resistive rod RMR to the other components of the read device. As the current Imr is constant, the variations in resistance of the magneto-resistive rod RMR caused by the magnetic-field variations to which the read head is exposed generate variations in voltage. In other embodiments of the invention, the magneto-resistive rod may be polarized by means of a constant voltage, in which case the data signal consists of a current that is a copy of the current flowing through the magneto-resistive rod.

The detection means include means for comparing the value of the data signal with a threshold value Vc, which comparison means are formed by a comparator C0, which receives the data signal Vmr at a non-inverting input and a signal having the threshold value Vc at an inverting input. An output of the comparator CO supplies a control signal Sel, which is representative of the result of such a comparison, and which serves to inhibit or authorize the compression operation, which control signal, in this example, is at a logic level 0 if the value of the data signal is lower than the threshold value Vc, and at a logic level 1 if the value of the data signal is higher than the threshold value Vc, i.e. when a thermal asperity is identified by the detection means.

In the example described here, the compression means CMP include a high-pass filter HPF, intended to filter the data signal Vmr, and a multiplexer MUX, which is provided with a data input for receiving the data signal Vmr, with another data input connected to an output of the high-pass filter HPF, and with a selection input for receiving the control signal Sel.

By virtue of the invention, the multiplexer MUX supplies an output signal OUT, which is representative of the variations of the data signal Vmr, but which is free of any additional component which would be introduced by a thermal asperity into said signal, without being altered by a noise-generating systematic compression.

Figs. 2 and 3 clearly show these advantages: under normal operating conditions, i.e in this example before t = t1, the data signal Vmr exhibits oscillations around a constant value V0, which is equal to R0.Imr, RO being the resistance of the magneto-resistive rod when it is not subjected to any magnetic field in particular, the flexible conductor FLX exhibiting only a negligibly small resistance. The oscillations are representative of local magnetic field variations to which the read head is exposed when it is being moved with respect to the support on which the magnetic information is stored. The frequency of the oscillations of the data signal Vmr is in fact much higher than the frequency which has been chosen here in order to improve the readability of the Figs. 2 and 3. The variations of the data signal Vmr are such that its instantaneous value does not exceed the threshold value Vc. The control signal Sel then is at the logic level 0 and the multiplexer MUX directs the data signal Vmr towards its output, which data signal constitutes the output signal OUT and is not altered by a compression operation, which is unnecessary under normal operating conditions.

When, at t = t1, a thermal asperity occurs, this asperity introduces an additional component TA, represented by dotted lines in Fig. 2, into the data signal, thereby

causing a sharp increase of the value of the data signal Vmr. The thermal asperity is detected by the detection means when the value of the data signal Vmr exceeds the threshold value Vc, which has been chosen to be, in this case, 25% higher than the nominal amplitude of the oscillations of the data signal Vmr under normal operating conditions. As a result, the control signal Sel switches to the logic level 1, and the multiplexer MUX replaces the data signal Vmr with the output signal of the high-pass filter HPF in order to form the output signal OUT. The Figures clearly show that the additional component TA introduced by the thermal asperity can be considered to be a DC-component with respect to the oscillations of the data signal Vmr. This DC-component is filtered by the high-pass filter HPF, which, on the other hand, remains transparent to the oscillations caused by magnetic-field variations to which the read head is exposed. Thus, only a minor perturbation of these oscillations in the output signal OUT occurs, which is caused by the increase of the value of the data signal Vmr prior to the instant t = t1, at which the detection means have effectively identified the thermal asperity.

The additional component subsequently decreases approximately exponentially as a result of progressive cooling down of the magneto-resistive rod. After t = t2, the instantaneous value of the data signal Vmr again becomes smaller than the threshold value Vc, and the control singal Sel returns to the logic level 0, and the multiplexer MUX again directs the data signal Vmr towards its output, which data signal Vmr then constitutes the output signal OUT. A minor perturbation of the output signal OUT is observed between the instant t2 and the instant at which the additional component TA effectively becomes zero, in which interval the maximum value of the output signal is higher than the maximum value under normal operating conditions, but the difference is so small that an amplifier receiving this OUT signal is insensible thereto. Thus, the compression only effectively takes place in the interval [t1; t2] in which a thermal asperity is detected. Outside this interval, the output signal OUT is formed by the data signal Vmr itself and hence is free from any alteration.

Figs. 4 and 5 are block diagrams showing different embodiments of the compression means CMP. These variants take advantage of the fact that a high-pass filter can be considered to carry out a subtraction between the signal to be filtered and the low-frequency component of this signal.

Thus, in a first variant described with reference to Fig. 4, the compression means CMP include:

- a subtracter SUB provided with a first input for receiving the data signal Vmr, a second input, and an output for supplying an output signal OUT of the device,

- a non-linear gain module NLG for receiving the data signal Vmr at an input, and for supplying an output signal, the gain of this module NLG being substantially zero when the absolute value of its input signal Vg is below the threshold value Vc, and
- a low-pass filter LPF provided with an input for receiving the output signal of the non-linear gain module NLG, and with an output, which is connected to the second input of the subtracter SUB.

In a second variant as described with reference to Fig. 5, the compression means CMP include:

- a subtracter SUB provided with a first input for receiving the data signal Vmr, a second input, and an output for supplying an output signal OUT of the device,
- a non-linear gain module NLG for receiving the output signal OUT of the device at an input, and for supplying an output signal, the gain of said module NLG being substantially zero when the absolute value of its input signal is below the threshold value Vc, and
- an integrator INT provided with an input for receiving the output signal of the non-linear gain module NLG, and with an output, which is connected to the second input of the subtracter SUB.

The two variants shown in Figs. 4 and 5 are advantageous in that they enable the detection means to be incorporated in the compression means, the function of detection means then being performed is ensured by the non-linear gain module NLG. Indeed, as long as the value of the data signal Vmr is below the threshold value, the gain of this module NLG is substantially zero, which means that the output signal OUT is formed by the data signal Vmr, with the subtracter SUB receiving a zero signal at its second input. When the value of the data signal Vmr exceeds the threshold value Vc, i.e., with reference to Figs. 2 and 3 which are also representative of the functioning of the compression means described by means of Figs. 4 and 5, when a thermal asperity is detected at t = t1, the low-frequency content of the data signal Vmr or of the output signal OUT, i.e. the additional component TA, is extracted by the low-pass filter LPF or by the integrator INT, respectively, and subtracted from the data signal Vmr. In both cases, the output signal OUT is freed of the additional component TA, the compression thus performed only occuring when the existence of such an additional component is detected, yet without necessitating the implementation of comparators or multiplexers.

Fig. 6 diagrammatically shows the shape of a transfer characteristic of a non-linear gain module used in the variants of the invention described hereinabove. When the

absolute value of an input signal Vg is below the threshold value Vc, the gain of this module is zero, thus enabling the compression means to be activated only when a thermal asperity occurs.

CLAIMS:

1. A method of reading magnetic information by means of a read head, which is to be placed proximate to a support at the surface of which information is stored, which read head includes a magneto-resistive rod which is to be polarized by means of an electric signal of constant value and serves to supply a data signal whose variations are representative of the magnetic-field variations to which the read head is exposed, which method includes a data signal compression step which is triggered off when a thermal roughness is detected.

2. A method as claimed in claim 1, wherein the value of the data signal is compared with a predetermined threshold value, the result of said comparison either inhibiting or triggering off the compression step.

3. A method as claimed in claim 1, wherein the compression step consists in subjecting the data signal to high-pass filtering.

4. A device for reading magnetic information, comprising:
a read head, which is to be placed proximate to a support at the surface of which information is stored, which read head comprises a magneto-resistive rod, which is to be polarized by means of a constant electrical signal and serves to supply a data signal whose variations are representative of magnetic field variations to which the read head is exposed,

- detection means for detecting a thermal asperity, and
- compression means for compressing the data signal, which are to be inhibited as long as no thermal asperity is detected.

5. A read device as claimed in claim 4, wherein the detection means include means for comparing the data signal value with a predetermined threshold value, which comparison means are intended to supply a control signal which is representative of the result of such a comparison and which serves to inhibit or authorize the compression operation.

6. A read device as claimed in claim 5, wherein the compression means include a high-pass filter.

7. A read device as claimed in claim 6, wherein the compression means additionally include a multiplexer, which is provided with a data input for receiving the data signal, with another data input which is connected to an output of the high-pass filter, and with a selection input for receiving the control signal.

8. A read device as claimed in claim 4, comprising:

- a subtracter, which is provided with a first input intended to receive the data signal, a second input, and an output intended to supply an output signal of the device,
- a non-linear gain module, intended to receive the data signal at an input, and to supply an output signal, the gain of this module being substantially zero when the absolute value of its input signal is below a predetermined threshold value, and
- a low-pass filter provided with an input intended to receive the output signal of the non-linear gain module, and with an output connected to the second input of the subtracter.

9. A read device as claimed in claim 4, comprising:

- a subtracter, which is provided with a first input for receiving the data signal, a second input, and an output for supplying an output signal of the device,
- a non-linear gain module, intended to receive the output signal of the device at an input, and to supply an output signal, the gain of said module being substantially zero when the absolute value of its input signal is below a predetermined threshold value, and
- an integrator, which is provided with an input for receiving the output signal of the non-linear gain module, and with an output connected to the second input of the subtracter.

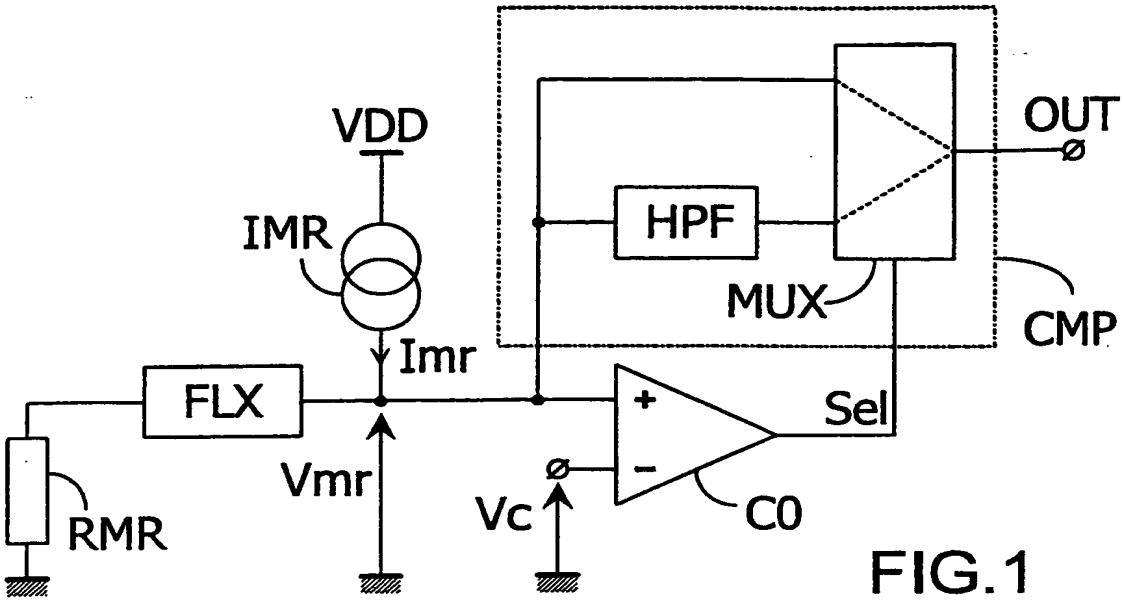


FIG.1

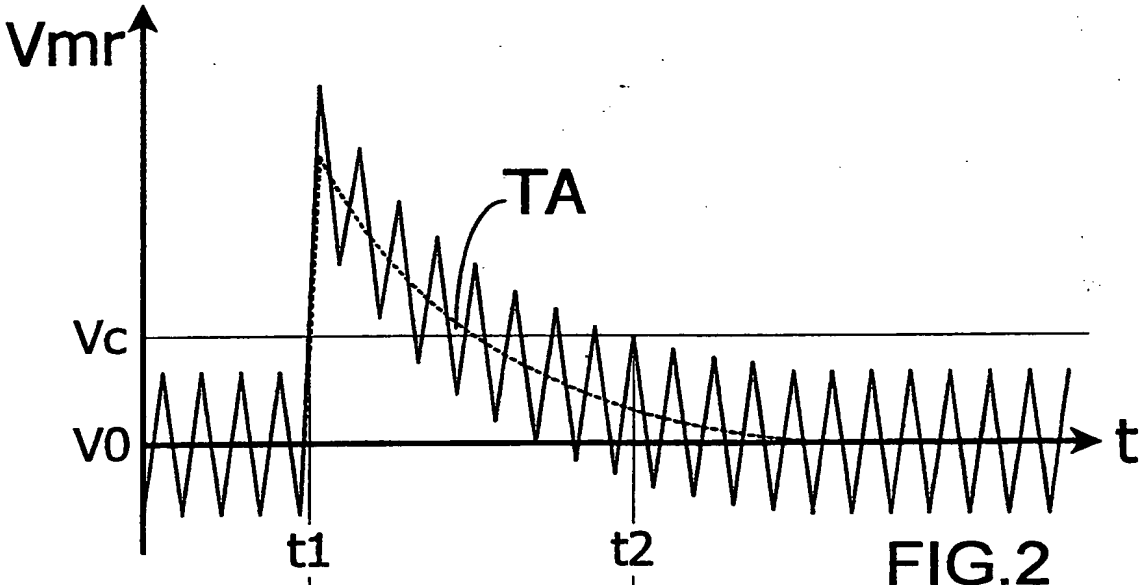


FIG.2

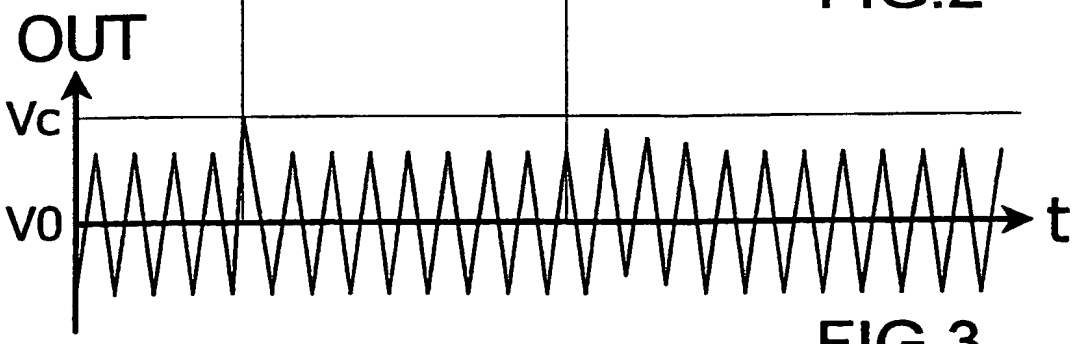


FIG.3

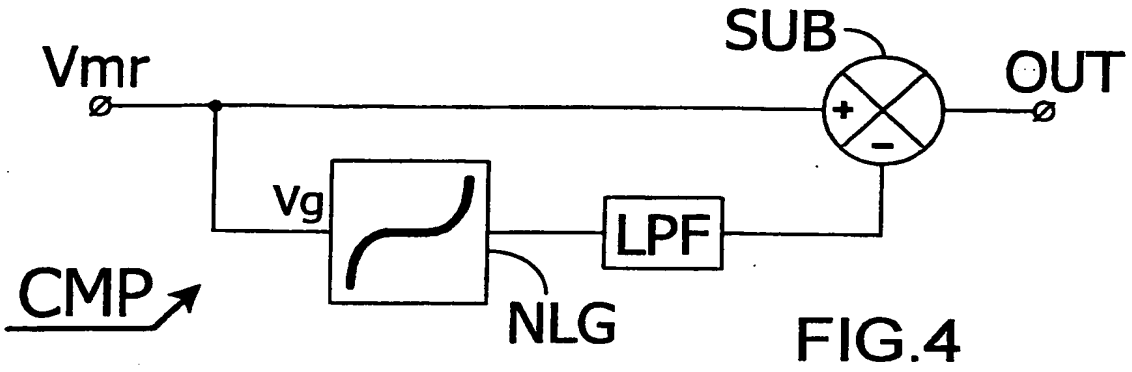


FIG.4

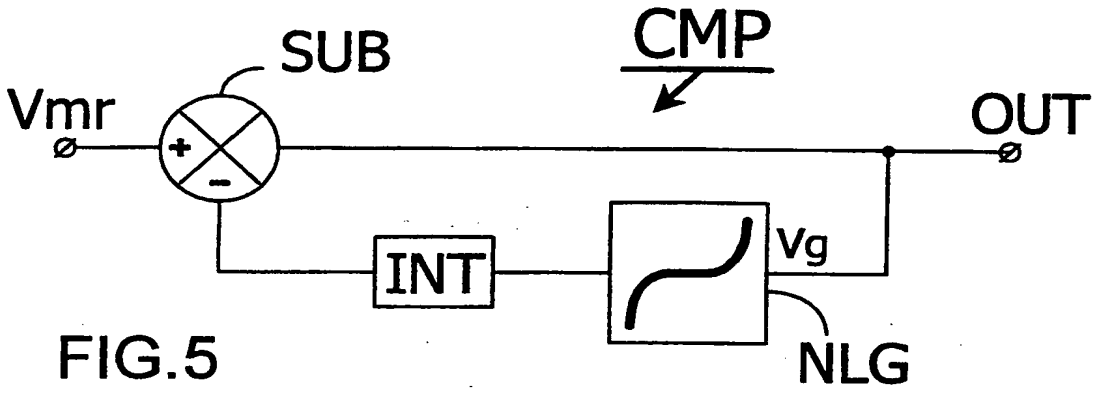


FIG.5

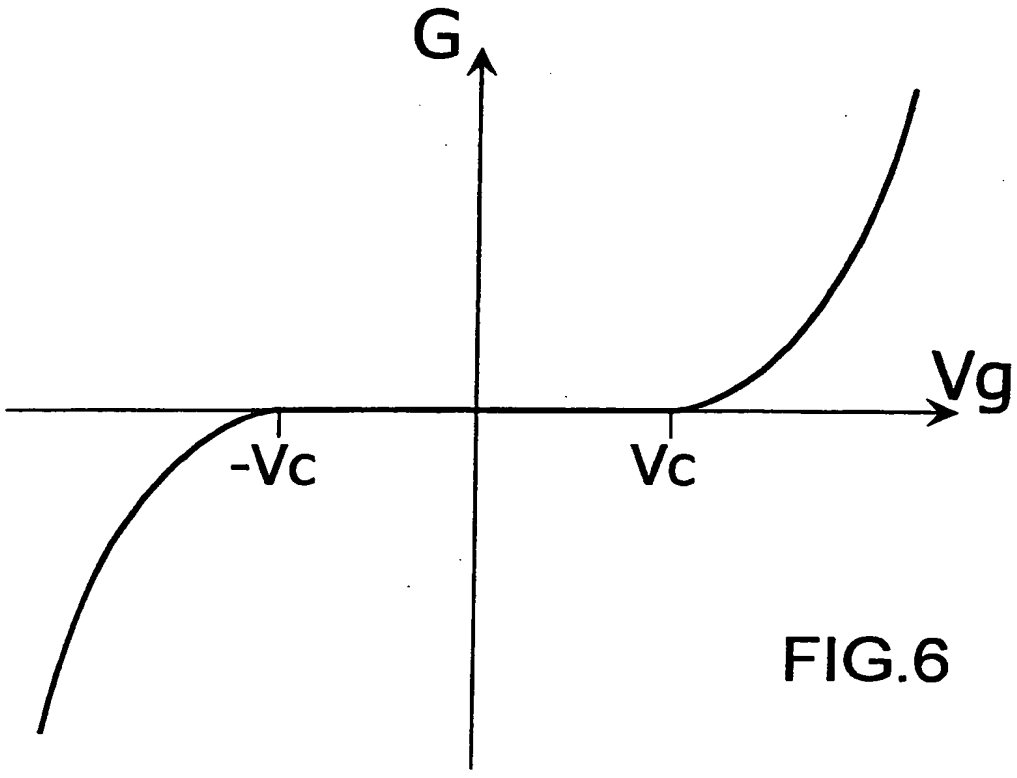


FIG.6